Cultural Heritage and Sustainable Valorization in the Governorate of Tartous with Reference to the Euromed IV Project: The Contribution

IV Project: The Contribution of Geomatics

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Abstract. Six Mediterranean countries are participating in the "Mare Nostru project: "A Heritage Trail along the Phoenician maritime routes and through historic port cities"; the goal of this project is to valorize the cultural heritage the sites involved by promoting and supporting sustainable tourism. WP4 c centrates on the port cities of Tyre and Tartous, chosen as pilot sites. The on research was conducted in accordance with the WP4 objectives: on the hand a survey campaign was set up to acquire metric and qualitative data on structures chosen as samples; on the other hand an enormous amount of pho graphic and video documentation was collected for the 3D models that w produced in the first phase. The paper will describe how the disciplines volved in Geomatics can provide important contributions to all four phases the Heritage and Development framework.

Keywords: Cultural Heritage, Laser scanning, Virtual Tour, Cultural Mappi

1 Cultural Heritage and Sustainable Valorization

Six Mediterranean countries (Syria, Lebanon, Greece, Italy, Malta and participating in the "Mare Nostrum" project: "A Heritage Trail along the P maritime routes and through the historic port cities"; the goal of this pr valorize the cultural heritage of the sites involved by promoting and s sustainable tourism.

This goal is being achieved by: raising public awareness of the importan serving and promoting sites; valorizing and promoting the Cultural Herita different Mediterranean basin cultures in a more communicative way; effective management plans to reduce the marginalization of archaeological to enhance the centuries-old port-city relationship; defining management target sites that will promote sustainable tourism.

WP4 concentrates on Syria and Lebanon where the port cities of Tyre tous (including the nearby Arwad Island which is already on the World Tentative List) have been chosen as pilot sites. In both cities WP4 has to

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nean map that connects all the port cities involved in the project; place ex
panels on site to provide information for tourists.

The concept of sustainability has a double meaning when it is applied t
heritage management: in the physical sense it means that excessive concent
tourists have to be avoided to ensure that the conservation of the cultural l
not compromised; in the economic sense it means limiting the cost-benefits
tial and thus increasing the capacity for promoting development. Conserva
agement planning and the model for sustainable valorization can be inte
evolve a new model wherein heritage serves as the core of the developmen
This process moves through four phases: *Awareness*- Development begins
identification of resources which have to be documented and studied to har
potential use; *Appreciation*- Development emphasizes public participation i
heritage activities; *Protection*- The tools of reference are heritage charters
policies and practices) and conservation guidelines (technical standards); *Ut*

2 The Contribution of Geomatics

The contribution of geomatics does not only consist in the application of
information technology procedures but creates a new methodological behav
the data acquisition and management process. Geomatic techniques can play
role because they provide innovative and more complete ways of describi
which, in their turn, allow approaches at different levels:

1. Geomatic techniques can manage enormous quantities of data relating t
geographic location but generated at different times;
2. Extra features can be added to the representation field during the resea
using processing to reconstruct modifications that have taken place over time
3. Georeferencing of data makes possible to lin the existing relationship
cultural heritage objects;
4. The knowledge acquired can be widely disseminated on-line;
5. The information can also be transferred to external databases and web site

To sum up, the research for this project uses geomatic techniques to propos
tive ways of using case studies, allowing diverse analogous elements (the
linked to each other in the Phoenician commercial maritime routes syste
considered simultaneously. In this sense it is possible to propose hypotheses
izing these heritage objects which take into account a series of conditions
accessibility, current transformations within the area, relations between
important monuments which profoundly effect their use. The use of thes
objects should be seen as an opportunity for increasing our understanding of

The disciplines involved in Geomatics provide important contributions t
phases of the Heritage and Development framework: awareness, appreciatio
tion and utilization.

other a powerful tool for communication. To provide the cultural heritage w
powerful system for learning, enriched by information technologies, is c
first step towards a better understanding of the sites and an essential ste
their appropriate valorization.

3 Description of the Places

Tartous was founded in the 2nd millenium B.C. as a coastal settlement on
longing to Aradus (the present day Arwad), a small island 3 km away and
most important Phoenician city–states. It expanded as an independent city
Emperor Constantine and his son Costanzo II. The city was conquered by
636 and was of little importance until it was taken by Raymond de San Gil
the First Crusade. In the second quarter of the 12th Century the Cathedr
Lady of Tortosa, one of the best preserved Crusader religious buildings, wa
fortified structure makes it unique among the Latin churches of the Near Eas

In 1152 Tartous became one of the main settlements of the Knights Ter
built the Citadel in the north-west corner of the city. This Citadel was built
ble concentric walls and a double moat. Although dwellings were later bu

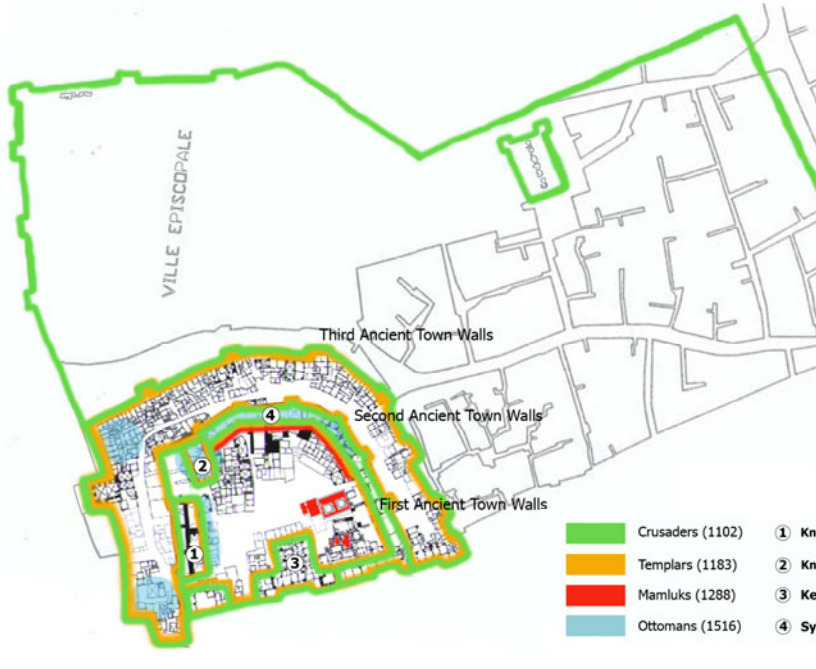

Fig. 1. Historical phases of the Citadel of Tartous. The numbers indicate the most
examples of Crusader architecture that are still recognizable.

Tartous is currently the second most important city on the Syrian coast main centre of a network of important points of interest for culture and tou relationship with Arwad has now been reversed: the island is only a small depends mainly on local daily tourism. There are significant remains of th cian Aradus on the island including the imposing remains of the walls facin The importance of Arwad during the Crusades is testified by the presen castles, one built by the Crusaders on the highest point of the island, the oth the Arabs by the sea.

There are other important archaeological remains 7 km from Tartous at A temple known as Maabed, is a basin carved into the rock surrounded by stone with an altar in the centre, which holds water from a nearby sprin there is a necropolis with underground tombs and two monuments called Me

There are also the remains of the docks of a port and a stadium from the H period. Further from Tartous there are other important sites of cultural int of the most interesting is the Hosn Suleiman archaeological area (the anci cece), a sanctuary dating from Phoenician times with a well preserved sac sure and the remains of two temples dedicated to Zeus and Astarte. There a ous castles in the area which date back to the Crusades. The White Castle the Al-Marqat Castle and the Krak des Chevaliers, the most famous and served of the castles of the Crusade period, were all inspected during the mis

4 Goals and Methodological Choices

During previous WPs, graphic, cartographic, iconographic and bibliographi was gathered for pilot sites and so, after an inspection, it was possible to d area on which to concentrate the on-site research. Studies by G. A. Negl Bouteflika were used as references for the urban analysis of Tartous and the ing area; the "Memorandum on Sustainable Urban Development in Syria "Workshop on the preservation and development of the old city of Tartous GTZ and the Syrian Ministry of Local Administration and Environment, information on guiding principles and programmes in the important areas policy and management.

The on site research was conducted in accordance with the WP4 objectiv one hand a survey campaign was set up to acquire metric and qualitative d structures chosen as samples; this provided the necessary information for th atic analysis (chronological phases, construction techniques, state of pre required for preparing conservation guidelines; on the other hand an amount of photographic and video documentation was collected for the 3I that were produced in the first phase; this documentation is being used for n popularization and communication of the most interesting sites: architectura landscape and archaeological sites.

In particular: integrated topographic and laser scanning techniques wer provide a metric survey of the Knights' Chapel and the urban spaces Citadel; the most interesting parts of Tartous (the Citadel and the Cathedral

4.1 Metric and Thematic Survey

The metric surveys and the studies of the materials and construction techni
mainly carried out in the old city of Tartous. The urban fabric has a complex
because of its pronounced vertical stratification. The Knights' Chapel and
vaulted galleries, both situated in the inner circle of the city walls, and a p
wall circle (Figure 1) were chosen because they have best preserved the pec
acteristics of Crusader architecture. Three-dimensional metric surveys were c
to obtain the disposition of masses on an urban scale as well as the detail re
analyzing wall textures. A topographical network with 7 vertices was define
ure, 59 topographical targets which were necessary for the alignment and refe
of the range maps acquired. An HDS6000 phase-based scanner was used for
survey. The shooting geometry and the scanning resolution were modulated
adapt them to the morphological characteristics of the spaces. Data was acqu
different view points to ensure uniform data coverage and to minimize an
"shadow areas". Documenting the Chapel's morphometric characteristics, th
techniques used, the extrados of the vaults, the fallen down parts and the th
the walls was a complex business partly because it was difficult to obtain ac
adjacent private spaces but also because it was difficult to transfer the referen
around the building. A total of 43 scans were carried out: 20 for the Knights'
for the Ottoman galleries, 5 for the portion of the town walls and 11 to doc
urban fabric in which these structures are inserted.

In the parts that have been studied it is possible to measure the size of th
their shape, the workmanship involved and the construction criteria used
variety of wall building techniques has been documented. As an example:
wall from the Chapel is made up of perfectly squared parallelepiped blocks
for important buildings; portion of wall from the service galleries, is con
small blocks of rather irregular shape in a homogeneously textured wall surf

4.2 Image Recording

All the sites that are part of WP4 – the Cathedral/Museum of Tartous, the C
Amrit site and Arwad - have been documented using the most innovative di
niques available to produce spherical panoramas, high resolution image mo
digital stereo images. More than 14.000 photos were taken to cover the dif
pects of the mission: they show the places, the architecture, the landscapes
dents and the local handicraft production as well as documenting the differ
of the work. A panoramic head, combined with a 15 mm fish-eye lens, wa
photographing complex or particularly wide spaces that could not be cov
single photo and panoramas were elaborated using cylindrical equirectangul
tion. The individual photos were mounted using software so they could be
as 2D files and explored as immersive environments. About 70 panora
mounted: each one was made up of an average of 21 photos and a maxim
photos. Up to 3 stop bracketing was used for every single photo: these mul

dinamic range) images.

5 Graphic Output

The total points model obtained after the alignment and referentiation of maps is an extremely versatile 3D database as it allows graphic output to be to meet specific requirements. Extracting information from the data gather scanning systems is a complex time-consuming post-processing operatio quires special software and skilled personnel. The following information c tained from the range maps: plans, elevations and vertical sections; 2D ima range map; 3D static and dynamic digital models. Further information can be from the photographic archive: spherical panoramas; high resolution image digital stereo images.

Table 1. Summary table of metric survey and image recording data

METRIC SURVEY DATA (Tartous Citadel)	
Tartous Citadel total area	about 31.000 mq
Survey area	about 6.900 mq
Surveyors	4
Topographic survey	
Total station	Leica TCR 303
Closed traverse	1
Open traverse	1
Vertices	7
Least-squares adjustment (stdev)	80^{cc}, 11 mm
Laser scanner survey	
Laser scanner	Leica HDS6000
Laser scanner stations	43
Acquired targets	59
Acquired spatial coordinates	185.018.130
Registration mean absolute error	0.006 m
IMAGE RECORDING DATA (Tartous and surroundings)	
Photographers	2
Cameras	Nikon D3, D90 and D700
Fixed lenses	15mm f/2.8, 24mm f/2.8, 50mm f/1.
Zoom lenses	18-200mm f/3.5-5.6, 18-55mm f/ 5.6, 24-70mm f/2.8
Image resolution	D90: 4288x2848 - D3 and D 4256x2832
Photographed locations	16
Avg. number of photos in panoramas	21
Shots for each picture	3
Avg. panorama resolution	360°x80°: 6.000x3.200
Max panorama resolution	360°x40°: 72.000x3.600
Texture pictures	160
Camera and video shooting time	42’33”

nication potential: 3D digital modelling as a method for checking the reconstruction; 3D and kinetic digital modelling as a tool for understandi education and communication; 3D digital modelling for representing morp transformations. The preliminary results of the surveying campaign underta Tartous area during WP4 of the Mare Nostrum project are presented below.

A. Plans, Elevation and Vertical Sections The following drawings h produced:

– A plan (Figure 2) which was realized by integrating a previous survey of the Citadel with the survey undertaken by our working unit. This mixed plan was completed with an orthogonal image of the range maps of all the connecting areas (lanes and the main square) in order to show the extension of the on-site data acquisition.
– Vertical sections (Figure 3) to analyze the urban morphology and the relationship among the buildings.

Fig. 2. Integration of the existing p present situation and the plan extra the points cloud

B. Bidimensional Images Obtained from the Range Map. A precise digital model can simulate 2D images so well that the human eye cannot distinguish these images from perspective photographic representations. The 2D image shown in F example of the remarkable levels of detail that can be obtained using scan tems. Obviously, temporal information i.e. the condition of the object at t was surveyed, is collected along with the geometric information.

This peculiarity, intrinsic to laser scanner data, has many positive uses fo search and for setting up multimedia instruments for popularizing, prom explaining the project to different user categories).

Fig. 3. Transversal section BB' passing through the Knights' Chapel

interactivity, which allows users to extract information (2D and 3D), makes such models ideal instruments for setting up virtual museums which popularize and explain the museums' contents. But this is only one of their possible applications. As these models possess the fourth dimension, time, they introduce a dynamic element to both representation and comprehension. This factor is extremely important as it provides a r checking historical reconstructions and for representing morphological transfo

Fig. 4. 2D image of the total point the Knights' Chapel

D. Panoramic Images. The images were organized in a database managed Lightroom 3. This software allows the images to be catalogued using met series of information connected to the files containing the images. Some formation is memorized when the photo is taken, such as the date, the type used, the lens focus, the time and the diaphragm. Other information can b subsequently by designing a suitable thesaurus. About 60 keywords have be fied for cataloguing the images belonging to this project which means it is p ble to undertake detailed research within the database. This method of ma has made over 30 GB of photographs accessible to the various members of group and will also make it possible for researchers outside the WP4 group find images. The position from which the photos were taken is also known the GPS system connected to the camera. This type of information, known ging, facilitates the use of these images allowing them to be managed in i ways such as classifying them on the basis of geographic proximity. The panoramas (Figure 5) can be used in various ways: to enable the use of inter- virtual spaces on the internet or on CDs; to integrate chromatic informatio points cloud; in pairs for photogrammetric restitution (spherical photogramm

Fig. 5. Spherical panorama inside the vaulted galleries (Citadel of Tartous

6 Towards a "Shared Cultural Mapping"

There has always been a direct relationship between tourism and cartograp
of travel routes and general information about the areas to visit are used in
the destination and in planning travel and stay. Today cartography is numer
used on line. Geographically referred data can be questioned, cross-checked
and it can be a valid tool for understanding and valorizing planning activiti
as informing and preparing visitors. Cultural mapping is a process of collec
lyzing and synthesizing information in order to describe the cultural resou
works, links and usage patterns in a community. The technological revolutio
an enormous impact on the information content available on-line and has gi
the phenomenon known as user-generated content (UGC). Photos, films,
text comments are placed on blogs, podcast guidebooks, social network sit
content multimedia sites and Wiki at an uncontrollable rate, allowing an
audience to access contents that would not have previously been available
places described had been visited in person. This enormous amount of con
to form opinions among internet users regarding tourist destinations and
offered and in fact influences the choices made by future travelers. These te
cal innovations are opening the way for so-called virtual tourism which lets
travelers anticipate their travel experience thereby stimulating their curi
increasing their interest in the areas visited.

Making a cultural mapping involves many different categories in a par
approach: residents, administrators, schools, tourist operators, and gene
perspectives and prepares the ground for effective cultural planning. A map
greater potential than an inventory; it communicates a rapidly increasing a
information and appreciation, it draws attention to the cultural area identify
ously unknown resources and activities, it provides the possibility of looki
from different perspective thereby gaining objectivity and overview and c
gaps, needs and overlaps. The work to be undertaken, in the EuroMed Mare
project, will contribute to programming sustainable development by help
form tourism into an element that valorizes the environmental and cultura
of a given territory as well as consuming them. The future of the tourist in
pends on the conservation of the environment in which it takes place. The
required are: to increase the awareness of the population regarding the cul
tage of their own country, to sensibilize visitors and to train tour operators. A
innovative and experimental measures should also be taken in order to ident
gies and instruments for reducing the pressure of tourism on the environme
improving the quality of the environment in areas that will remain mass tou
tinations (for example the Island of Arwad where the visible degradation is
large numbers of visitors).

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